Tampa Bay

By Larry Handley[1], Kathryn Spear[1], Lindsay Cross[2], René Baumstark[3], Ryan Moyer[3], and Cindy Thatcher[1]

Background

Tampa Bay is Florida's largest open-water estuary and encompasses an area of approximately 1036 km^2 (400 mi^2) (Burgan and Engle, 2006; TBNEP, 2006). The Bay's watershed drains 5,698 km^2 (2,200 mi^2) of land and includes freshwater from the Hillsborough River to the northeast, the Alafia and Little Manatee rivers to the east, and the Manatee River to the south (Figure 1). Freshwater inflow also enters the bay from the Lake Tarpon Canal, from small tidal tributaries, and from watershed runoff. Outflow travels from the upper bay segments (Hillsborough Bay and Old Tampa Bay) into Middle and Lower Tampa Bay. Southwestern portions of the watershed flow through Boca Ciega Bay into the Intracoastal Waterway and through the Southwest Channel and Passage Key Inlet into the Gulf of Mexico. The average depth in most of Tampa Bay is only 3.4 m (11 ft); however, 129 km (80 mi) of shipping channels with a maximum depth of 13.1 m (43 ft) have been dredged over time and are regularly maintained. These channels help to support the three ports within the bay, as well as commercial and recreational boat traffic.

[1] U.S. Geological Survey National Wetlands Research Center, 700 Cajundome Blvd., Lafayette, LA 70506

[2] Tampa Bay Estuary Program, 263 13th Ave South, Suite 350, St. Petersburg, FL 33701

[3] Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 100 8th Avenue SE, St. Petersburg, FL 33701

Tampa Bay was deemed an “estuary of national significance” by the US Environmental Protection Agency’s National Estuary Program, and the Tampa Bay Estuary Program (TBEP) was established in 1991. The TBEP mission is to build partnerships to restore and protect Tampa Bay through implementation of a scientifically-sound, community-based management plan. This comprehensive conservation and management plan (CCMP) is also known as “Charting the Course” (TBNEP, 1996).

More than 2.5 million people live in the three counties that border Tampa Bay (Pinellas, Hillsborough and Manatee), with nearly 3.3 million in the six-county watershed (Burgan and Engle, 2006), and the population is expected to increase by 10 to 20 percent over the next decade. There are three major seaports in Tampa Bay located in Tampa, St. Petersburg, and northern Manatee County that generate approximately $15 billion for the local economy and support 130,000 jobs. Recreational boating is popular, with more than 100,000 recreational boats registered in the area. Tampa Bay generates $5 billion each year through trade, tourism, development, and fishing and attracts approximately 5 million tourists annually. Like other estuaries within the National Estuary Program, Tampa Bay is ecologically and economically rich, providing a wealth of ecosystem services to a growing human population. Many important species of wildlife, including shrimps, crabs, dolphins, sea turtles, manatees, and numerous bird and fish species use Tampa Bay for habitat. The bay is an important nursery area for the endangered Kemp’s Ridley sea turtle (TBEP, 2009). Approximately 40,000 pairs of 25 species of wading and shore birds nest around the bay and more than one-third of the state’s roseate spoonbill population nests on the bay’s mangrove islands each year (TBEP, 2009). One-sixth of the Gulf’s manatee population winters in the bay, and more than 200 species of fish—the most abundant being the bay anchovy—use the bay for at least part of their life cycle. Finding the necessary balance between meeting the ecological needs of the estuary, including its emergent wetland habitats, and the commercial, recreational, and residential needs of the human population is a central focus of many agencies around the bay area and essential to the long-term protection of the bay.

Methodology Employed to Determine and Document Current Status

The mapping protocol consisted of stereoscopic photointerpretation, cartographic transfer, and digitization in accordance with strict mapping standards and conventions. Other important aspects of the protocol included the use of the Cowardin Classification System (Cowardin et al., 1979), groundtruthing, quality control, and peer review. Land, water, and areas where emergent wetlands were present were included on the maps.

The information derived from the photography was subsequently transferred using a zoom transfer scope onto a stable medium overlaying U.S. Geological Survey (USGS) 1:24,000-scale quadrangle basemaps. The 1956 data were derived from U.S. Department of Agriculture 1:20,000-scale, black and white aerial photography. The 1972 data were derived from National Aeronautics and Space Administration (NASA) 1:80,000-scale, color infrared aerial photography. The 1982 data were derived from NASA 1:24,000-scale, color infrared aerial photography. In those cases where the data were inadequate or incomplete, contemporary supplemental data were acquired from other sources and used to complete the photographic coverage.

Groundtruthing included the participation of field staff from the USFWS and Florida Marine Research Institute during two separate phases of the project. The first phase was during the time of aerial photo acquisition through pre-interpretation. The second phase was during project groundtruthing at the time of completion of the draft maps. Draft maps were sent to USFWS and Florida Marine Research Institute staff for review and comments. All comments received were incorporated into the final maps.

Methodology Employed to Analyze Historical Trends

Historical emergent wetland trends were analyzed by comparing changes in total areal coverage of emergent wetland habitat along a time sequence for 1956, 1972, and 1982. Emergent wetland acreages were analyzed for 1956, 1972, and 1982 by watershed to determine overall losses and gains and potential causes and effects of changes within the estuary. Maps of emergent wetland distribution for these years were studied to determine the location of major changes of coverage.

Status and Trends

Emergent wetland monitoring during 1956, 1972, and 1982 (Figures 2-4) illustrates the changes in areal extent of emergent wetland habitat in Tampa Bay (Table 1). Tampa Bay lost 3,035 hectares (7,500 acres), or 32.0%, of its emergent wetlands between 1956 and 1972; and it lost an additional 1,444 hectares (3,568 acres), or 15.2%, of its emergent wetlands between 1972 and 1982. Over the entire 27-year study period, Tampa Bay lost 4,479 hectares (11,068 acres), or 47.2%, of emergent wetland habitat.

Table 1. Emergent wetland acreage in Tampa Bay for 1956, 1972, and 1982.

Emergent Wetland Type	1956	1972	1982	Total Change 1956-1982

	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres
Estuarine	1,941	4,797	1,479	3,655	1,402	3,463	-540	-1,334
Palustrine	7,554	18,666	4,981	12,308	3,615	8,932	-3,939	-9,734
Total	9,495	23,463	6,460	15,963	5,016	12,395	-4,479	-11,068

Between 1956 and 1972, Tampa Bay lost 462 hectares (1,142 acres), or 23.8%, of salt marsh. A loss of 77 hectares (462 acres), or 9.6%, of salt marsh occurred between 1979 and 1982. A total of 540 hectares (1,334 acres), or 27.8%, of salt marsh was lost during the entire 27-year study period.

Tampa Bay lost 2,573 hectares (6,358 acres), or 34.1%, of coastal fresh marsh between 1956 and 1972. An additional loss of 1,366 hectares (3,376 acres), or 18.1%, of fresh marsh occurred between 1972 and 1982. A total of 3,939 hectares (9,734 acres), or 52.1%, of coastal fresh marsh was lost in Tampa Bay during the entire 27-year study period.

Causes of Change

Habitat loss, plant and wildlife population declines, and pollution, particularly of excess nitrogen, are some of the main threats the Tampa Bay ecosystem currently faces. The Bay has lost approximately half of its marshes and 40 percent of its submerged aquatic vegetation (TBNEP, 1996) since the 1950s, when population growth began to increase rapidly (Burgan and Engle, 2006; Handley et al., 2007). The six counties within Tampa Bay’s watershed— Hillsborough, Manatee, Pasco, Pinellas, Polk, and Sarasota— experienced a 190% population increase from 1960 to 2000, as the population grew from 1.2 million to 3.3 million. The population density of the area was 640 people per 2.6 km^2

(1 mile^2) in 2000. Nearly half of the Bay's seagrass meadows and more than 20 percent of its estuarine marsh and mangrove habitat have been lost to development, dredge-and-fill activities, and degraded water quality since the 1950s (Robison, 2010). More than half of the shoreline has been altered for seawall construction, dredge-and-fill projects, and other hardening activities. The area has also lost a significant amount of native upland, intertidal, and subtidal plant communities. This loss of habitat has contributed to declines in commercial and recreational fisheries for many species of both finfish and shellfish. Spotted seatrout and other fish populations have faced rapid declines during the past half-century as habitat has been lost. Invasive species such as the Asian green mussel (*Perna viridis*), Brazilian pepper (*Schinus terebinthifolius*), and Australian pine (*Casuarina equisetifolia*), among others, have altered the native ecosystem in Tampa Bay and the surrounding watershed and are a growing concern for habitat managers.

The input of excess nutrients, which can lead to algal blooms and decreased water clarity, is a significant concern in Tampa Bay, primarily because of its impact on seagrass, which requires clear water to grow. Nitrogen sources include both point and nonpoint. Direct atmospheric nitrogen deposition, which falls directly onto the water surface, accounts for approximately one-fifth (17%) of the total nitrogen loadings in Tampa Bay. Nonpoint sources of nitrogen, including stormwater runoff and indirect atmospheric deposition (air emissions that fall first onto the watershed, then enter the bay via stormwater) accounted for 65% of the total loading in 2002 (Poor et al., 2012). The remaining 18% is from point sources of pollution such as domestic wastewater and industrial point sources (Poor et al., 2012). Recent improvements in water quality in the bay have been attributed to the efforts of many partners, beginning with improved treatment and disposal of wastewater discharge in the municipalities that surround Tampa Bay. Advanced wastewater treatment began in the Tampa Bay region in 1979, followed by improved treatment of stormwater in 1985. The quantity of nitrogen loading decreased dramatically from a high of ~10,000 tons of nitrogen/year in the 1970s to ~4,500 tons/year in the 2000s (Janicki, 2008). There has also been a shift from point source to nonpoint-source dominated loads. Recent improvements in water quality have come from the collective efforts of public and private entities engaged in the Nitrogen Management Consortium. Together, more than 45 entities have implemented more than 400 nitrogen reduction projects, resulting in a cumulative reduction of 550 tons of nitrogen loading to Tampa Bay between 1992 and 2011 (TBNMC, 2012). These reductions in nitrogen have led to a subsequent improvement in water clarity parameters (Sherwood, 2011) and an increase in seagrass acreage. Seagrass coverage decreased from more than 40,000 acres in the 1950s to 21,650 acres in 1982. Coverage has been steadily increasing with 32,897 mapped acres in 2010 (Sherwood, 2011). The overall goal for protection and restoration of seagrass in Tampa Bay is 38,000 acres (TBNEP, 1996).

The National Estuary Program Coastal Condition Report (2006) rated the overall condition of Tampa Bay as 'fair', based on a water quality index of 'fair', a sediment quality index of 'good', and a benthic index of 'poor'. Stormwater runoff and septic system malfunctions can result in occasional elevated levels of bacteria in Tampa Bay. Contaminated sediment, containing high levels of metals, organochlorine pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs), can be found predominantly around marinas, ports, and urban areas. The majority of this pollution comes from runoff from urban, industrial and agricultural areas, which may contain fertilizers, pesticides and chemicals. Some of this pollution also comes from recreational and commercial boats. Chemical and oil spills are an additional threat to Tampa Bay, with large quantities of oil and other toxic substances being transported through the bay annually.

Monitoring for Emergent Wetland Health

Urbanization and development in the highly populated region are major anthropogenic influences on the health of emergent wetlands within Tampa Bay. Urban development such as dredge and fill activities have been responsible for a majority of the historical habitat loss and degradation observed in Tampa Bay (Robison, 2010). Watershed urbanization also significantly changes natural hydrology and geomorphology which can result in reduced water quality. While these anthropogenic causes of degradation will continue to threaten emergent wetlands in Tampa Bay, other long-term threats associated with climate change, sea-level rise, and consumptive water use will likely cause more subtle changes over the next century. To address issues related to climate change and sea-level rise, long-term monitoring will be necessary. Monitoring water quality and areal extent of emergent wetlands provides an indicator of emergent wetland health, but local ‘upstream’ factors such as land-use change and land-based sources of pollution should also be part of any long-term monitoring to assess wetland health in Tampa Bay.

The Tampa Bay Estuary Program and partners involved with the Tampa Bay Habitat Restoration Partnership have recognized the value of habitat monitoring and are developing a Tampa Bay Critical Coastal Habitat Assessment. This long-term monitoring project, utilizing a multi-scale approach, will establish a baseline for coastal habitats and detect future impacts from climate change and other indirect anthropogenic impacts. This may include the use of automated techniques to create emergent tidal wetland vegetation spatial information from 4-band, 1-foot spatial resolution imagery proposed for collection by the Southwest Florida Water Management District (SWFWMD) (Robison, 2010). This type of spatial analysis could be supplemented with recently acquired high-resolution Light Detection and Ranging (LiDAR) elevation data and bathymetric data to determine low-lying coastal upland areas that should be prioritized for acquisition. These types of acquisition would allow for landward expansion of emergent wetlands in response to rising sea levels. This monitoring program will be used, in conjunction with monitoring of seagrass, water quality, and sediment quality, to guide future management of important estuarine and freshwater habitats in the Tampa Bay region.

Mapping and Monitoring Needs

Coverage of emergent estuarine and palustrine wetlands and seagrass has been assessed through aerial photography interpretation and land use change analyses on a periodic basis. The TBEP updates its Tampa Bay Habitat Master Plan every ten years and includes an extensive assessment of estuarine wetland change and development of protection and restoration targets (Robison, 2010). A follow-up project is extending the same change analysis and target-setting process to palustrine wetlands and will be used to guide freshwater wetland mitigation to projects that address identified needs within the watershed. Preliminary results suggest that there has been a loss of 168 hectares (416 acres), or 33 percent, of freshwater wetlands between 1950 and 2007 (Cross, et al., 2012).

There are other critical habitats that have not been extensively mapped or monitored and are priorities for future research. The 2010 Habitat Master Plan Update identified tidally influenced rivers as a focus area, recommending that the total linear miles of tidally influenced rivers and tributaries be quantified and periodically reassessed to evaluate long-term trends associated with sea-level rise and consumptive water use (Robison, 2010). More than 100 tidal tributaries have been mapped in the bay and several research projects have been initiated to better understand the importance of these habitats. A multi-partner research project in 2006 extensively studied nine tidal tributaries in the Tampa Bay watershed, including fish and invertebrate sampling, water and sediment quality monitoring, and exploration of the effects of watershed parameters such as condition of the surrounding watershed on fisheries usage. Project recommendations included maintaining connectivity with open bay waters to allow movement of fish, water flows, and nutrients and restoration of natural hydrology where feasible. TBEP and partners are now identifying barriers on tidal tributaries and designing a pilot project to remove a salinity barrier to restore natural hydrology and oligohaline habitats. Improved methods are needed to accurately and precisely quantify the smaller-scale changes expected to occur in the coastal and estuarine habitats of Tampa Bay. Along with remote monitoring techniques, long-term (several decades), field-based monitoring should be conducted to assess plant community and other functional ecological changes in emergent wetlands. For this type of monitoring program to be meaningful and effective, long-term resource commitments would be required by the TBEP and its partners. The Tampa Bay Critical Coastal Habitat Assessment sets the groundwork for this identified need.

A more systematic approach to adaptive management needs to be applied to future projects, particularly considering the long-term threats related to climate change and sea-level rise. Improved monitoring at both the project and ecosystem levels is critical for the successful implementation of adaptive resource management.

Restoration and Enhancement Opportunities

The original Habitat Master Plan, known as *Restoring the Balance* (Lewis and Robison, 1995) and the Habitat Master Plan Update (Robison, 2010) provide quantitative protection and restoration targets for Tampa Bay estuarine habitats. These targets have been vetted by environmental managers and citizens and subsequently adopted by local policy makers. These targets help prioritize habitat restoration design components, mostly within the context of the “mosaic approach” (Lewis and Robison, 1995). Rather than restore a single species, environmental practitioners strive to incorporate multiple habitat species and types within a project site. Habitat restoration has been effective at restoring priority habitats that have been lost, and these projects are tracked on an annual basis by the TBEP. Since the mid-1990s, 175 hectares (433 acres) of mangrove forest, salt marsh, and salt barren have been restored or established (Robison, 2010). However, despite these gains, as of 2010, salt marsh and salt barren were 776 hectares (1,918 acres) and 340 hectares (840 acres), respectively, short of their restoration targets. The restoration goal for mangroves is to protect the existing 6,127 hectares (15,139 acres) and opportunistically restore them (Robison, 2010).

In addition to establishing restoration targets and paradigms, *Restoring the Balance* (Lewis and Robinson, 1995) identified 28 sites for acquisition, protection, management, and/or restoration. Of these sites, 19 have been purchased and eight have undergone restoration activities. For the Habitat Master Plan Update (Robison 2010), TBEP and partners identified new priority acquisition and restoration sites by conducting a current inventory of public and private parcels in the Tampa Bay watershed that should be prioritized for restoration activities. New restoration sites were classified into 49 publicly owned sites and nine public-private partnership sites. Restoration activities range from invasive species control to restoration of hydrology. In order to assure long term preservation, conservation easements were recommended for most sites.

Exotic species management on public rights-of-way offers an additional opportunity for habitat restoration. Public rights-of-way also provide opportunities for coastal upland enhancement as well as upland scrape downs to create or restore emergent tidal wetlands. Priority public rights-of-way should be identified for the development and implementation of enhancement and restoration projects. Lands previously mined for phosphate also offer a significant potential to restore watershed hydrology. Re-establishment of historic floodplain functions and stream channels in the upper Alafia River would contribute to the restoration of tidal river flows in this important watershed (Robison, 2010).

Looking forward, it will become necessary to implement a comprehensive watershed approach for the acquisition of priority public lands as well as the design and implementation of larger projects. Larger projects can incorporate basin-level hydrologic restoration based on water resource management and structural habitat improvements. While not all portions of the Tampa Bay watershed can be considered in a watershed approach because of the extent of development and modification, opportunities for basin-level restoration should be explored wherever possible.

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Figure 1. Watershed for Tampa Bay.

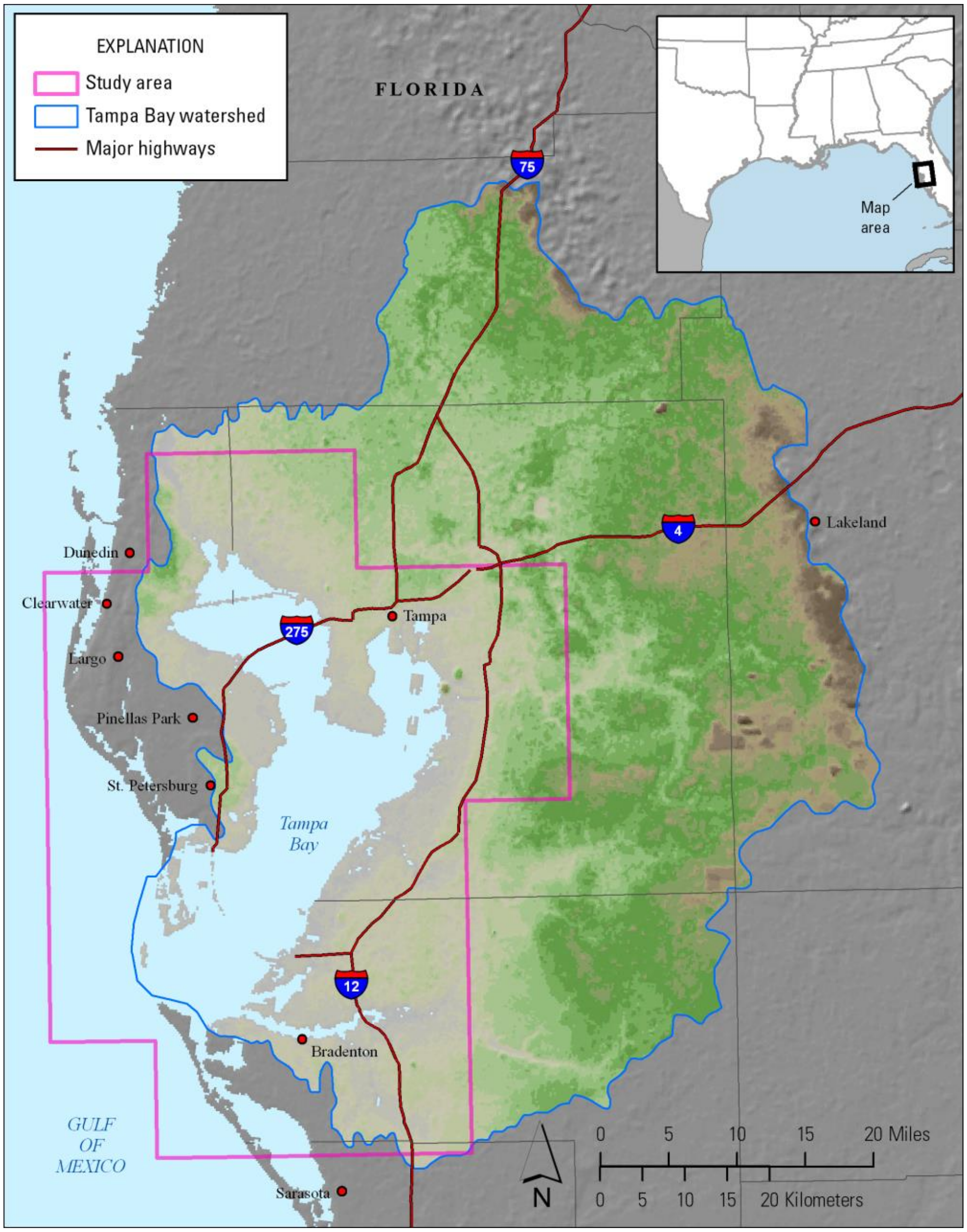

Figure 2. Distribution of emergent wetlands in Tampa Bay, 1956.

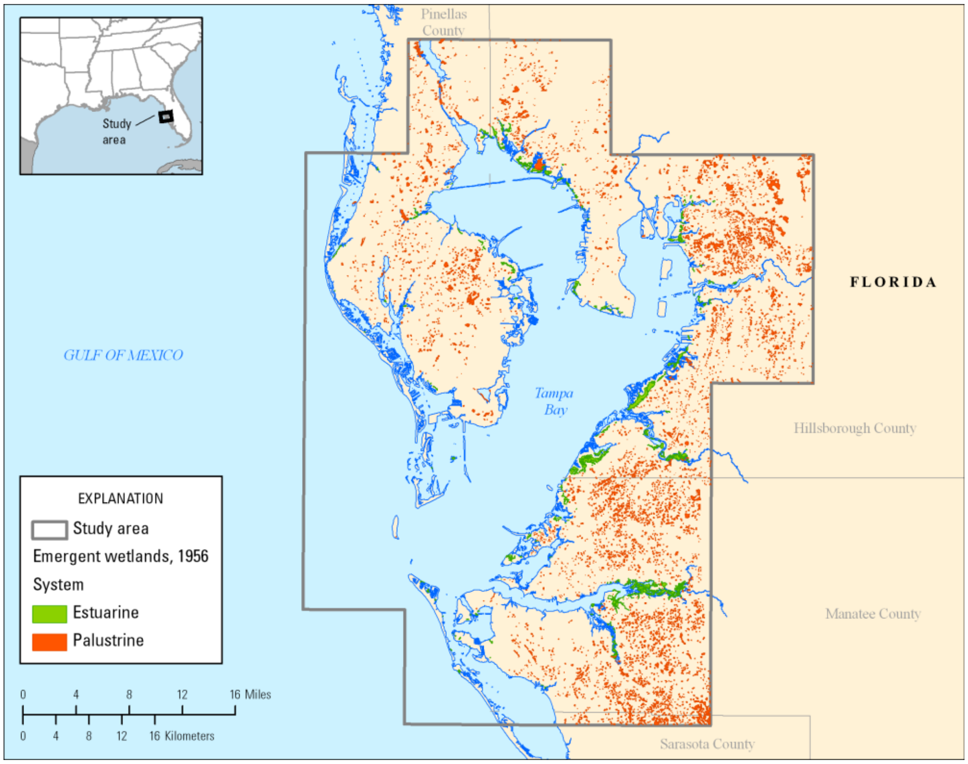

Figure 3. Distribution of emergent wetlands in Tampa Bay, 1972.

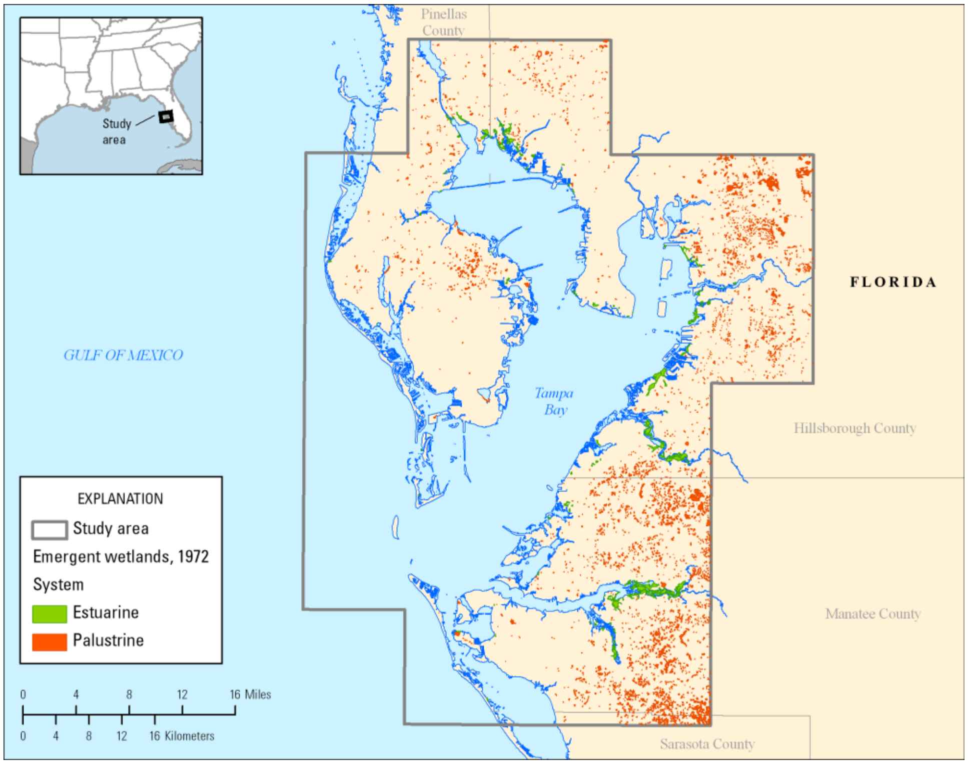

Figure 4. Distribution of emergent wetlands in Tampa Bay, 1982.